

Chapter L: The Acquisition Module

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Datapac 2K2 User's Manual, Ver 3

Chapter L: The Acquisition Module

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L-1. Introduction

The Datapac 2K2 Acquisition module is a full-featured, yet economical tool for acquiring analog data. Newly introduced in version 3.05 of the module is the ability to view incoming data in up to 8 scope emulating time series display windows all at the same time. Each display window can be configured completely independently. Therefore, you can use each one to display different channels with different color schemes, amplitude ranges, time bases, and other features. Additional highlights include individually selectable sampling rate on each input channel; sampling on non-sequential channels; file size limited only by available disk space or the operating system; automatic shut-off with manual override; display only and storage with display operation; triggered sweep and continuous sampling modes with an intermediate RAM storage option that permits extremely fast sampling rates for extended sampling intervals and simultaneous operation with other applications; flexible hardware configurations with up to 256 input channels¹; and integrated operation with the new Datapac Output Module. The Acquisition Module is designed to drive many different A-D device models available through RUN Technologies for ISA, PCI, and PCMCIA busses with 16 or 64 channel capacity and 12 or 16 bit resolution.


¹ PCM (notebook) hardware configurations are currently limited to 32 input channels using two 16 channel A-D cards.

L-2. Entering the Acquisition Module

The Acquisition module is designed to drive only certain A-D hardware devices – specifically, the ones that RUN Technologies supports. Therefore, before entering the module your **Preferences|ADC Hardware** and **Preferences|ADC Software** options must be set to a “RUN Tech...” option consistent with your installed hardware device. See Chapter 1, Section 1-5.4 for details. If you attempt to enter the module with different options established an error message appears telling you to set the options appropriately.

To enter the Acquisition Module, select the **Acquire** option from the main window menu bar or select the  icon from the main window tool bar. What happens next depends upon whether or not you already have a data file open when you enter the module. If you do have a data file open then the **Acquire Control Panel** appears immediately. Moreover, the program automatically sets up the displays and initializes the acquisition protocol using the parameters it retrieves from the open data file, so you are ready to acquire additional data to the file. See Section L-5 for further details. If you do not already have a data file open the program assumes that you wish to create one and opens the **New Data File Window**. Additional details are provided in Section L-3. Section L-3 also explains what to do if you have a data file open when you open the module but you wish to close it and create a new one.

L-3. The New Data File Window

The New Data File Window is used to enter the name of a data file that you are about to create. An example is shown in Figure L-1. The New Data File Window automatically appears when you enter the Acquisition Module without first opening a data file. If, on the other hand, you entered the module with a data file already open and you wish to close it and create a new one, you can access the New Data File Window by clicking the  (**New Data File**) button on the **Acquire Control Panel**.

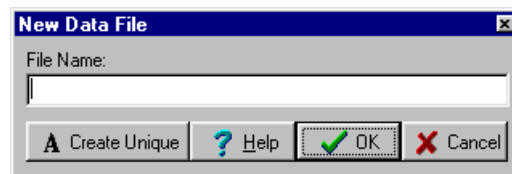


Figure L-1. The New Data File window.

Enter the file name you wish to use in the box below the **File Name** label. Enter only the filename prefix, not an extension². If you precede the filename with the name of a drive and directory (i.e., a "path" in PC jargon) the file is created on the directory you name. However, if you do not indicate a drive or directory the file is created on the directory that was designated as the default data file directory during system configuration. **Never enter an extension for the filename.** For example, if you wanted to create a data file named DFILE1 on the default data file directory, this is what you would type in the File Name box:

dfile1

² A Datapac 2K2 "data file" is actually a collection of several component files. The specific number of component files is dependent upon the specific file structure. But since the Acquisition module only supports RUN Technologies Structure E, three component files will be created in this context, each given a different extension (DAT, PER, and RET). All three files are created on the same directory. Likewise, when you attempt to open an existing data file, all three of the component files must be present on the same directory. For more information on the structure of data files, see Chapter 1, Section 1-2.

Likewise, if you wanted to create a data file named DFILE1 on a directory named RUN on Drive C, this is what you would type:

c:\run\dfile1

If you enter the name of an existing data file a warning message will appear, asking you if you wish to overwrite the file. If you elect to proceed, the existing contents of that data file are erased. The **Create Unique** button is present to ensure that you avoid that possibility. When you press the Create Unique button Datapac 2K2 generates a file name that is guaranteed to be unique. The only trouble is that the name will be a seemingly random string of eight characters. But since it is assumed that you are going to enter the name of the subject from which the data are obtained, as well as many other items of demographic information, and since you can sort your data files on these information items when later attempting to open the file, the actual file name is of little consequence.

Naming a data file when you want to create sequentially numbered files:

Datapac 2K2 has a feature that makes it easy to produce sequentially numbered data files. To use this feature you are required to use as the filename prefix of the first file in the sequence a name that ends in a three digit number. For example, if you enter:


dfile001

in the File Name box within the New Data File window, you can use the auto-incrementing feature to name subsequent data files dfile002, dfile003, dfile004, and so on. For additional information, see Section L-8.12.


The Subject Record Window


After entering the data file name and closing the New Data File Window, the **Subject Record Window** appears, allowing you to enter comments and information about the individual or "subject" contributing the analog data you are about to acquire. Additional information about the Subject Record Window can be found in Chapter 1, Section 1-7. After closing the Subject record window the **Acquire Control Panel** appears. Additional details are provided in Section L-5.

Initial Parameters of a Newly Created Data File


When you create a new data file many of its initial parameters are automatically obtained from the data file that was last opened in the Acquisition module. These parameters include the number of channels enabled and their sample periods, the title and calibration parameters associated with each channel, along with the type of acquisition mode and related options. Any of the parameters can be adjusted as desired, of course, but it makes it especially easy to copy all of the parameters used for a previously acquired data file to a new data file: just open the previously acquired data file possessing the characteristics you want to copy, then access the New Data File window to create the new data file with the same characteristics. You can also use the  **Load Acquisition Parameters** button on the Acquire Control Panel to load a set of previously saved parameters.

L-4. Adding Data to an Existing Data File

You can add data to an existing data file at any time – provided of course that the file is a Datapac 2K2 Structure E file. To add data to an existing data file, you must first open it. You can open an existing data file at any time, either before or after entering the Enhance Acquisition module. To open an existing data file, select the **File|Open Data File** option of the main window menu bar, or select the  icon from the main window tool bar. Additional details are provided in Chapter 1, Section 1-6.

To protect the integrity of the existing contents of a data file, the Acquisition module does not permit you to change any of the parameters that affect the file's structure if the file contains data. Specifically, you are not permitted to change the number of active channels or their sampling rates unless you erase all of the previously acquired data contained in the file. Use the  (**Erase File**) button on the Acquire Control Panel (just to the left of the reported **File:** value) to erase previously acquired data. Details are provided in Section L-8.9.

L-5. The Acquire Control Panel

The **Acquire Control Panel** is the primary interface for controlling acquisition within the Datapac 2K2 Acquisition module. This is the panel that you will use to perform almost all of the tasks related to acquisition. You use it to configure your acquisition protocol (e.g., to decide the number of active channels, the sampling rate, the maximum session and file durations), to open and close real time display windows, to add, edit, or view subject data and comments, and to turn acquisition on and off. You will also use it to create new data files, to save your existing set-up parameters to files and retrieve previously saved parameters, and to delete portions of previously acquired data. Additionally, the Acquire Control panel reports the acquisition status (that is, whether acquisition is on or off, and when on, what acquisition mode is being used), as well as the elapsed time of the current acquisition session, how much data has already been stored to the data file, and how many sweeps have already been acquired (when using the Triggered Sweep acquisition mode). From left to right, the three  buttons on the top row of the panel can be used to erase the data acquired in the last acquisition session, the entire data file, or the most recently acquired sweep. An example of the Acquire Control Panel is shown in Figure L-2.

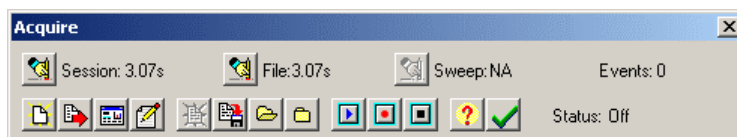


Figure L-2. An example of the Acquire Control Panel.


Preparing to Acquire Data: An Overview

Before you can acquire data you need to perform several tasks. Specifically, you need to format your acquisition protocol, select the number and types of displays you want to use to view the incoming data, and you need to format each individual display. Each of these steps are described below in more detail.

Format Your Acquisition Protocol

We use the term **acquisition protocol** to mean the parameters that govern how data are accumulated from the A-D device(s). Such parameters include the number of active A-D devices, the number of active channels on each device, the sampling rate and calibration values of each active channel, the acquisition mode (e.g., continuous or triggered sweep), the maximum session and file durations, and a few other particulars. For more information about setting up your acquisition protocol, see Section L-6.







Select Your Displays



The Acquisition module allows you to open as many as 8 individual real time display windows and configure them all individually. To select how many display windows will be open, click the  (**Format**) button in the Acquire Control Panel window, then select the **Display** tab when the Acquire Format window appears. See Section L-6.4 for further details.

Format Your Displays

Each of the display windows can present different information in different ways. You can present a different set of channels in each window, use a different display duration or gain settings in each one, or enable or disable a variety of other features in different windows. See Section L-7 for further details about formatting your displays.

Using the Scope, Acquire, and Stop Buttons to Control Acquisition

Once you have your acquisition protocol established and your displays opened and formatted you are ready to acquire data. There are two ways to do that, depending upon whether you want to only display the data that are being acquired, or to both display the data and store them to your data file. To initiate the display only method of acquisition click the  (**Scope**) button. Similarly, to initiate both storage and display, click the  (**Acquire**) button. To stop an ongoing session in either mode, click the  (**Stop**) button. These three buttons also have keyboard analogs. Specifically, you can hold down the Alt key and press the S key (**Alt+S**) instead of clicking the  button. Likewise you can hold down the Alt key and press the A key (**Alt+A**) instead of clicking the  button. Pressing the **Esc** key is the same as clicking the  (Stop) button. It should be noted, however, that *the keyboard analogs can only be used when program focus is on the Acquire Control Panel window*. The window's banner is greyed out when program focus is not on the window. To return the program focus to the Control Panel window, click on it.





It is no longer necessary to explicitly stop a session before beginning a new one. In other words, you don't have to click the  (Stop) button (or press the Esc key) to switch from Scope (display only) to Acquire (display and store) and vice versa. In fact, you can terminate an on-going Scope or Acquire session and begin a new one just by clicking the appropriate button again. For example, if you click the  (Acquire) button again while an Acquire session is already in progress, the on-going session terminates, the Session value is reset to zero, and a new one begins.

We just stated that the Acquire method allows you to both display and to store incoming data while the Scope method allows you to display the incoming data without storing them. But what if you wished to store the incoming data without displaying them? That's easy – just don't open any display windows. Remember, a great deal of processing power is required to generate real time displays, and the more processing power required for that purpose leaves less available for other tasks – including managing data storage. By eliminating displays altogether you can maximize the rate at which data can be stored to disk. That's not likely to be a concern for most users. But if you are acquiring many channels of data at very high rates, or if your CPU is slow, then it might be. See Section L-9 for more information on how to maximize your sampling rate.

Marking Significant Events from the Keyboard


The new Keyboard Marking feature makes it possible to identify the occurrence of significant events during the course of an acquisition session. No special procedures are required to enable the feature because it is automatically enabled whenever you start an acquisition session. To use it, just press one of the ten number keys whenever something of interest happens. Every time you press a number key an event is inserted into one of ten event files to log the time associated with the keypress. A black vertical line also appears within the scope display window to let you know that a key press has been recorded. Since a different event file is associated with each number key, up to 10 different categories of events can be recorded. See Section L-8.6 for additional details.


Erasing Already Acquired Data


The three  buttons on the top row of the Acquire Control Panel allow you to erase previously acquired portions of your data file. Specifically,  button to the left of the Session value lets you erase only the previously acquired session. Likewise, the  button to the left of the File value lets you erase the entire data file. And the  button to the left of the Sweeps value lets you erase the most recently acquired sweep. The latter is available only when the acquisition mode is set to triggered sweep.



L-5.1. Summary of Options in the Acquire Control Panel


This section briefly describes the various buttons and indicators contained in the Acquire Control Panel.


Session: Reports the elapsed time since the start of the acquisition session. To delete the contents of the last acquired session, click the  (**Erase Last Session**) button to the left of the Session value.


File: Reports the current duration of the data file -- in other words, it reports how much data has already been acquired into the data file. This value will continue to increase as new data are stored to the data file during an acquisition session. To delete the entire contents of the data file, click the  (**Erase File**) button to the left of the File value.


Sweep: While an acquisition session is running in the Triggered Sweep or Triggered - Ram mode, this item reports the number of sweeps accumulated in the current acquisition session. When no acquisition session is running this item reports the total number of sweeps accumulated in the data file. To delete the last acquired sweep, click the the  (**Erase Last Sweep**) button to the left of the Sweep value.

 (**New Data File**): Click this button to close the existing data file and create a new one. This is the button to use if you are not auto-incrementing your file names. If you are, then use the  (**New Data File -- Auto Inc**) button. See Section L-8.12 for details.

 (**New Data File -- Auto Inc**): Use this button to close the current data file and create a new one. This option can only be used if the filename prefix of the currently open data file ends in a three digit number. When the new file is created its filename prefix is automatically incremented by one. For example, if the current data file is named **Data001**, then the new file is named **Data002**. See Section L-8.12 for more information.

 (**Format**): Click this button to open the Acquire Format window -- the window used to establish the parameters of the acquisition protocol and to open and close the acquisition display windows. See Section L-6 for details.

 (**Edit Subject Record**): This button opens the Subject Record window, where you can enter and edit demographic data about the subject and to record comments.

 (**Load Acquisition Parameters**): Use this button to load (retrieve) a previously saved set of acquisition parameters. The acquisition parameters are the ones that are included in the Acquire Format window -- i.e., the acquisition protocol parameters that govern the number of A-D devices in use, the number and sampling rates of enabled channels, and the acquisition mode in effect, among other things. The acquisition parameters also determine the number and types of display windows that will be open, but *they do not include the detailed formatting parameters for those windows*. Display format parameters are contained in the display parameter files. See Section L-8.11 for details. Since the acquisition parameters affect the structure of the data file it is only possible to load an acquisition parameter file when the data file is empty. The button is inactive at all other times.



(Save Acquisition Parameters): Use this button to save the currently selected acquisition parameters to a parameter file so that you may retrieve them at a later time. The acquisition parameters are the ones that are included in the Acquire Format window -- i.e., the acquisition protocol parameters that govern the number of A-D devices in use, the number and sampling rates of enabled channels, and the acquisition mode in effect, among other things. The acquisition parameters also determine the number and types of display windows that will be open, but *they do not include the detailed formatting parameters for those windows*. Display format parameters are contained in the display parameter files. See Section L-8.11 for details.



(Load Display Parameters): Use this button to load (retrieve) a previously saved set of display parameters. When loaded from the Acquire Control Panel the display parameter file includes the parameters associated with all of the currently open display windows, if they are available. However, they do not specify which display windows are actually open. That is determined by the Display tab of the Acquire Format window, and the parameters contained in the display tab are considered to be part of the acquisition parameters. See Section L-8.11 for additional details.



(Save Display Parameters): Use this button to save the parameters associated with all of the currently open display windows. It should be noted that a display parameter file does not contain the parameters that determine which display windows are open when the file is saved. That is determined by the Display tab of the Acquire Format window, and the parameters contained in the display tab are considered to be part of the acquisition parameters. See Section L-8.11 for additional details.



(Scope): Use this button to initiate the real time display without simultaneous data storage.



(Acquire): Use this button to begin an acquisition session in which analog data are both stored and displayed.




(Stop): Use this button to terminate an on-going acquisition session. The **Escape** key also performs the same function.



Close: Use this button to close the Acquisition module. As the module closes all of the acquisition and display parameters that are currently in effect are written to default parameter files. The contents of the default parameter files are then retrieved when you re-open the module, thus restoring your acquisition environment to the way it was when you last exited the module.

L-6. Formatting Acquisition

The parameters of the acquisition protocol -- that is, the parameters that govern how data are accumulated from the A-D board(s) -- are accessed by clicking on the  (**Format**) button in the Acquire Control Panel. Doing so opens the **Acquire Format window**. An example is presented in Figure L-3.

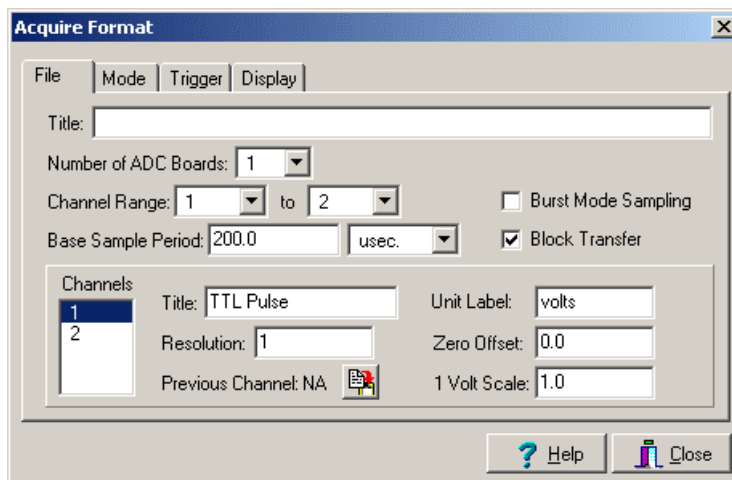


Figure L-3. An example of the Acquire Format window.

As you can see, the Acquire Format window is broken down into four tabbed sections: **File**, **Mode**, **Trigger**, and **Display**, although the **Trigger** tab appears only when the **Mode** option in the **Mode** tab is set to **Triggered Sweep** or **Triggered Sweep - RAM**. The contents of each tab are described briefly below. Details are provided in the next four subsections.

File: Contains the parameters that determine the structure of the data file. These include the number of A-D boards in use, the channels to be acquired from each (whether or not they are displayed), the base sample period, the title of the data file, and the title, resolution, and calibration parameters of each individual channel.

Mode: Contains the parameters that determine the acquisition mode (continuous, triggered sweep, continuous to RAM, or triggered sweep to RAM), the maximum session and file durations, and enables/disables the Delay and TTL Start features.

Trigger: This tab appears only when the **Mode** option in the **Scope** tab is set to **Triggered Sweep** or **Triggered Sweep - RAM**. It contains the parameters that determine the trigger conditions that cause a sweep to occur. These include the trigger channel, the trigger level and slope, the pretrigger interval, and the maximum number of sweeps to acquire before acquisition terminates.

Display: Lets you decide how many display windows to open.

L-6.1. The File Tab of the Acquire Format Window

An example of the Acquire Format window's File Tab is shown in Figure L-4. The parameters contained in the File tab are of fundamental importance because they, more than any other set of parameters, determine what data are acquired during an acquisition session. And the most important of those are the **Number of ADC Boards**, the **Channel Range**, the **Base Sample Period**, and the individual channel **Resolution** parameters, for they are the ones that determine the contents and organization of the data file you are about to create. It is for this reason that they cannot be edited unless the data file is empty.

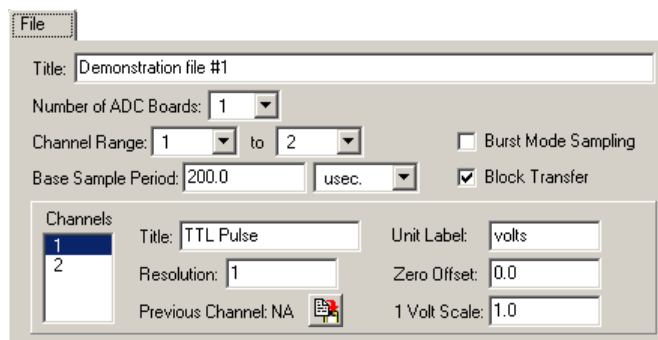


Figure L-4. An example of the Acquire Format window's File tab.

The parameters in the File tab can be considered as two types: general parameters and channel specific parameters. General parameters affect the file as a whole or the sampling characteristics as a whole. Channel specific parameters affect individual channels.

General Parameters

The **Number of ADC Boards** parameter determines the number of active A-D devices. The **Channel Range** determines the number of active channels on *each* A-D device. Thus, if two A-D devices are active and the channel range is 1 - 6, then the first six channels are active on each device to make a total of twelve active channels. The **Base Sample Period** determines the minimum interval between successively captured samples in any given channel. For example, if the Base Sample Period is set to 100 usec., then the minimum interval between successive samples in any given channel is 100 usec, which is equivalent to 10,000 samples per second, or 10,000 Hz. Different channels can be sampled at different rates, however, by selecting different **Resolution** values for each one. The **Resolution** parameter is a multiplier term, and it can be different for each individual channel. Specifically, it is used to multiply the Base Sample Period value, thus determining the sample period for each individual channel. For example, if the Base Sample Period is 100 usec, and the Resolution value associated with a particular channel is 10, then the sample period employed for that channel is 10 x 100 usec, or 1 msec. The channel is therefore sampled at a rate of 1000 Hz.


The **Block Transfer** and **Burst Mode Sampling** options refer to different methods of accumulating data off the A-D device(s), and both options are only relevant for A-D devices manufactured by Measurement Computing Corp (formerly Computer Boards, Inc.) as well as certain models of A-D devices manufactured by Keithley. If you have an A-D device manufactured by Measurement Computing Corp or (or Computer Boards, Inc.) always make sure the **Block Transfer** check box is checked. If you have an A-D device manufactured by Keithley, always make sure the Block Transfer check box is cleared. If you have an A-D device manufactured by IOTech, then it doesn't matter.




Burst Mode Sampling affects the time interval between successively sampled channels. All of the A-D devices currently supported by the Datapac 2K2 Acquisition module are multiplexed designs. That means they have a single A-D converter capable of converting one value in one channel at any given moment in time. The A-D converter is preceded by a multiplexer which switches between successive active channels as time proceeds. In other words, if four channels are active, a sample will be accumulated in channel 1, then some time later a sample will be accumulated in channel 2, then channel 3, then channel 4, before the sequence is repeated. We call the time interval between successively sampled channels the **lag**. When enabled, burst mode sampling minimizes the lag between successively sampled channels.


Channel Specific Parameters

The boxed section at the bottom of the File tab report the parameters established for individual channels. To view and edit the parameters established for a given channel, highlight its number in the **Channels list box** along the left edge of this section. The operation of the **Resolution** parameter was discussed in the previous section in relation to the Base Sample Period parameter. It affects the sampling rate for the individual channel. The **Title** is a text string that you can use to identify the highlighted channel throughout the rest of Datapac 2K2. The **Unit Label** is a text string that you can use to describe the amplitude units for the highlighted channel. The default label is "volts" since that is what is ultimately accumulated by the A-D device, but you can change it to anything you want it to be. Finally, the **Zero Offset** and **1 Volt Scale** are the highlighted channel's amplitude calibration parameters. Specifically, the **Zero Offset** specifies the raw voltage value that will be interpreted as amplitude = 0. The **1 Volt Scale** parameter determines how a 1 volt change in raw voltage will be interpreted after calibration.

For example, say you want the incoming signal in Channel 1 to represent displacement values in centimeter units. Also assume that you want the raw voltage value of -2.30 volts to represent the displacement value, 0.00 cm. Finally, assume that you want a 1 volt change in the original input signal to represent 10 cm of displacement. The parameter values necessary to achieve the desired result would be: **Zero Offset = -2.30** (because you want -2.30 volts to be interpreted as 0.00 cm displacement), and **1 Volt Scale = 10** (because a 10 cm change in displacement corresponds to a 1 volt change in the signal). Finally, set the **Unit Label = cm** so that the amplitude values are labeled in units of "cm" elsewhere in Datapac 2K2. Changing the unit label is not essential, only cosmetically pleasing.

It is also worth noting that a channel's title, unit label, and amplitude calibration parameters can be changed at any time before, during, or after your data file is acquired. To access these parameters outside of the Acquisition module, select **File|Calibrate Channels** from the main window menu bar or click on the  icon in the main window's tool bar.

 The parameters contained in the File tab (as well as the other tabs in the Acquire Format window) default to the values employed by the data file that was open when the Acquire Control Panel was last accessed. The file parameters can also be saved to parameter files for later use by selecting selecting the  (**Save Acquisition Parameters**) button in the Acquire Control Panel window. Likewise, they can be retrieved using the  (**Load Acquisition Parameters**) button.

 Since they are essential to the configuration of the data file, many of the parameters within the File tab can only be adjusted when the data file contains no analog data. If the data file contains any analog data at all, they will be greyed out and inaccessible to prevent corruption of the file.

L-6.2. The Mode Tab of the Acquire Format Window

An example of the Acquire Format window's Mode tab is shown in Figure L-5. The **Mode** tab contains the parameters that determine the overall operation of the acquisition protocol -- basically, when and how data are acquired. Of these, the **Mode**, **Max[imum] Sess[ion] Dur[ation]**, and **Max[imum] File Dur[ation]** are the most important.

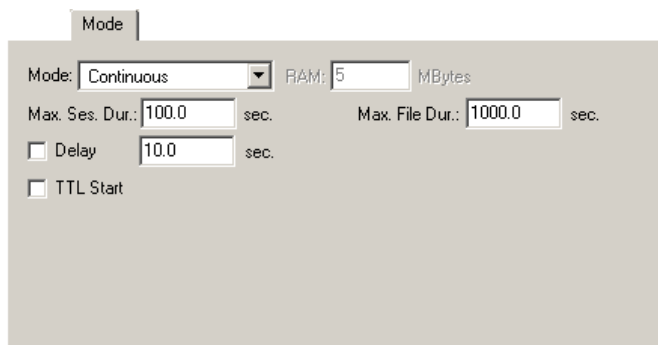





Figure L-5. An example of the Acquire Format window's Mode tab.


The **Mode** parameter determines the acquisition mode. There are two basic modes -- Continuous and Triggered Sweep. However, you also have a choice of two primary locations where the incoming data may be stored -- hard disk or RAM memory. Consequently, there are a total of four acquisition mode options. When you are only displaying the incoming data - i.e., when you are using the **Scope** option in the Acquire Control Panel - the primary storage location is irrelevant because data aren't being stored. It is only when you select the **Acquire** option that the primary storage location becomes important. See Section C-11.2 for additional information.

The **Max[imum] Sess[ion] Dur[ation]** and **Max[imum] File Dur[ation]** are similar in the sense that they both serve as pre-determining counters to automatically terminate acquisition. The **Max[imum] Sess[ion] Dur[ation]** parameter determines the maximum duration of a single *acquisition session*. Likewise, the **Max[imum] File Dur[ation]** parameter determines the maximum duration of the entire file. Data can be accumulated to the same data file over several acquisition sessions. Consequently, the **Max[imum] File Dur[ation]** value should always be greater than or equal to the **Max[imum] Sess[ion] Dur[ation]** value.

 When you are only displaying the incoming data - i.e., when you are using the **Scope** option in the Acquire Control Panel - the **Max[imum] Sess[ion] Dur[ation]** and **Max[imum] File Dur[ation]** parameters are not relevant because no data are being stored. It is only when you select the **Acquire** option that these parameters become important.

The **TTL Start** feature postpones the beginning of an acquisition session until the rising edge of a TTL pulse is detected at the TTL-IN port. This of course assumes that you have already selected the  (**Acquire**) button or  (**Scope**) button in the Acquire Control Panel. In other words, the TTL-IN port is not examined for the occurrence of a pulse until the Acquire or Scope button is selected. Then, when a pulse is detected, the session begins.

The **Delay** feature provides a method of automatically re-arming the A-D devices after the Delay interval times out. Thus, when the Delay feature is in effect, *the first acquisition session* begins at the moment you select the **Acquire** button in the Acquire Control Panel (assuming the TTL Start feature is disabled). If the first acquisition session is allowed to run to completion (as determined by the **Max. Sess. Dur.** parameter in the **Continuous** mode, or jointly by the **Max. Sess. Dur.** and **Max. # Sweeps** parameters in the **Triggered Sweep** mode), then the delay interval commences. When that second delay interval times out, a second acquisition session automatically begins. This sequence continues until the **Max. File Dur.** value is attained, or until acquisition is terminated manually.

 The Delay and TTL Start features can be used in combination to effectively simulate a triggered sweep environment. See Section L-8.10 for details.

L-6.3. The Trigger Tab of the Acquire Format Window

The Acquire Format window's Trigger tab contains the parameters that determine the trigger conditions that cause a sweep to occur. An example of the Trigger tab is presented in Figure L-6. The tab appears only when the acquisition **Mode** option in the **Mode** tab is set to **Triggered Sweep** or **Triggered Sweep-RAM**.

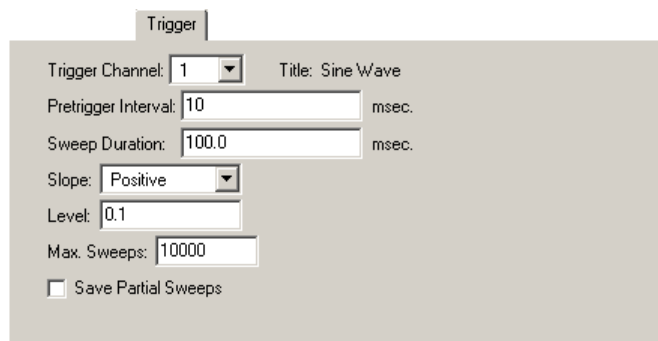


Figure L-6. An example of the Acquire Format window's Trigger tab.

A **trigger** is defined as a change in amplitude in the selected **Trigger Channel** of sufficient magnitude to cross the **Level** value. Moreover, the Level value must be crossed in the correct direction, which is determined by the **Slope** parameter. If the Slope is set to **Positive**, the level must be crossed from below to above. Conversely, if the Slope is set to **Negative**, the level must be crossed from above to below.

The Trigger tab also determines the Sweep Duration and the Pretrigger Interval. The **Sweep Duration** is the total amount of time for which data are acquired around each detected trigger. The **Pretrigger Interval** is the portion of the sweep that occurs prior to the onset of the trigger.

The **Max. Sweeps** parameter is yet another predetermining counter that you can use to automatically terminate an acquisition session. For example, the Max. Sweeps value is set to 10000 in Figure L-6. That means that 10000 sweeps must be accumulated in the current acquisition session before the session is automatically terminated. Also keep in mind that the Max. Sweeps parameter works in concert with the other predetermining counters – namely the Max. Session Duration and Max. File Duration parameters (the latter two are found in the Mode tab). In other words, a session terminates as soon as any one of the three counter values are reached, whichever comes first.

Finally, the **Save Partial Sweeps** checkbox determines whether a sweep must be completed in order to be saved to the data file. In other words, if you terminate an acquisition session while a sweep is being collected, that sweep will not be saved to the data file unless the Save Partial Sweeps check box is checked.

L-6.4. The Display Tab of the Acquire Format Window

The Display tab of the Acquire Format Window is used to open and close individual real time display windows. If you weren't such a tightwad and purchased the Enhanced Acquisition module instead of the Acquisition module, you could also select the type of display to be shown in each window. But the Acquisition module is limited to time series displays – the kind of display that is similar to an oscilloscope. An example of the display tab is shown in Figure L-7 (again, Slider, Gauge, and Digital display types are available only in the Enhanced Acquisition module – aren't you jealous?).

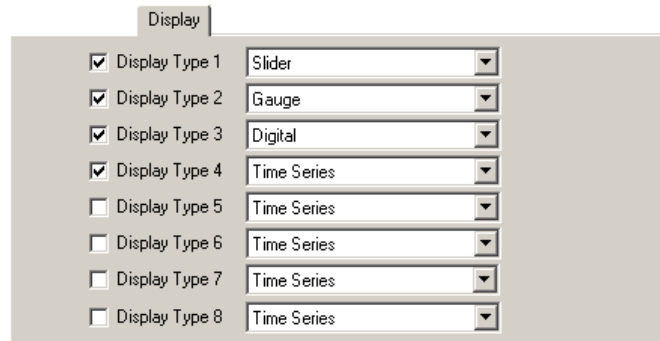



Figure L-7. An example of the Acquire Format window's Display tab.

Up to 8 display windows can be open simultaneously. To open a display, check the checkbox on the corresponding line. For example, in the illustration above there are four checkboxes checked. Therefore four different display windows are active (the display windows open when you exit the Acquire Format window). In this example the type of display selected for each active window happens to be different. But in the Acquisition module you can only select time series displays.

 The Display tab is only used to open and close display windows. Once you open a display window you must format it. See Section L-7 for details on how to format each window.

L-7. The Time Series Display

The time series type of display is very similar to a standard multi-channel oscilloscope, where the amplitude of each incoming signal is plotted against time. An example of a time series display is shown in Figure L-8 with its various components labeled.

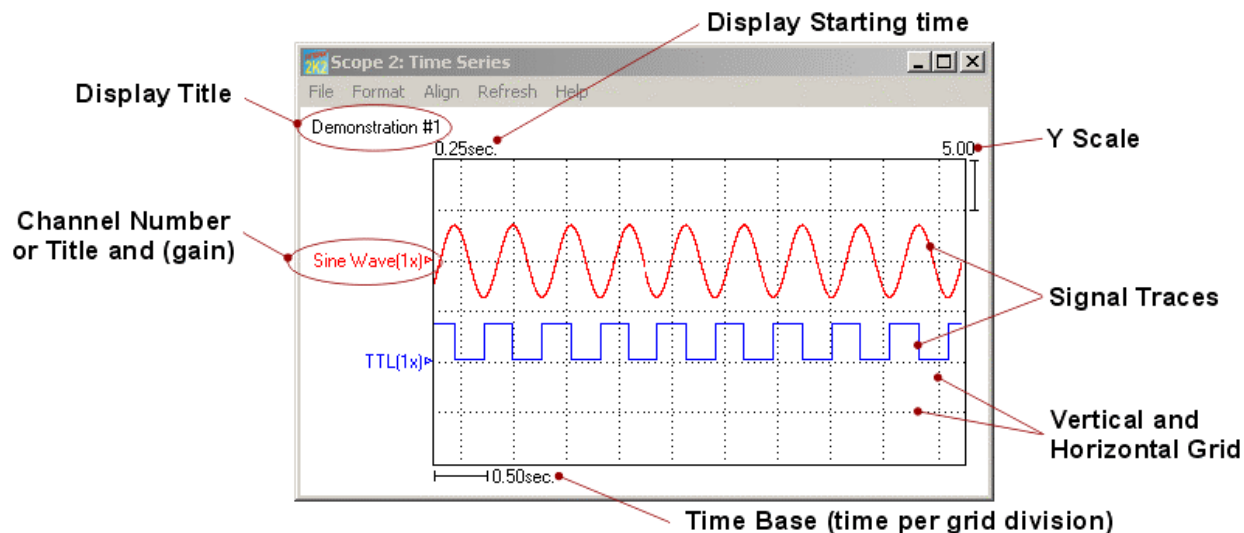




Figure L-8. An example of the time series display type with its components labeled.


The example shown in Figure L-8 contains two channels of data, but you can set up the display to contain as many channels as you want. You can present all of the channels in different colors, or you can use the same color for as many as you want. Likewise, you can adjust the gains of each channel independently. The channel colors and gains, as well as all of the other parameters that affect the appearance and performance of the display, can be adjusted by selecting the **Format** option in the window's menu bar. See Section L-7.1 for details. You can also adjust many of the parameters using the hot spots embedded in the display, as described below. Once you have the display formatted the way you want it you can save its parameters to a user-generated parameter file, or retrieve a previously saved set of parameters, by selecting the **File** option in the menu bar.


Locations and Functions of the Display Hot Spots

"Hot spots" are locations in the display that can be used to adjust particular display parameters quickly and easily. The available hot spots are described below. Finer adjustments to the Y-scale value, individual channel display gains, and the time base (sweep duration) can be performed using the **Format** option in the display's menu bar.

 **Align (Position) Individual Channels:** Move the mouse pointer outside the left edge of the display box and position it on the number or title of the channel you wish to move. Press the shift key and hold the left mouse button as you move the mouse. As you do so a horizontal line appears in the display box to monitor the zero reference level of the channel as you move it. A message also appears in the bottom right corner of the window identifying the channel being moved.

 **Adjust Display Gain of Individual Channels:** Move the mouse pointer outside the left edge of the display box and position it on the number or title of the channel you wish to adjust. Hold down the CTRL key and click the left or right mouse button, respectively, to increase or decrease the channel's display gain by a factor of two each time.

 **Adjust Time Base:** Position the mouse pointer on the time base value located below the bottom left corner of the display box, hold down the CTRL key, then click the left or right mouse button, respectively, to increase or decrease the time base by a factor of two each time.

 **Adjust Y-Scale Value:** Position the mouse pointer on the Y-Scale value reported above the right corner of the display box. Hold down the CTRL button and click the left or right mouse button, respectively, to increase or decrease the Y-scale value by a factor of two each time.

L-7.1. Formatting A Time Series Display

The **Time Series Format window**, illustrated in Figure L-9, is used to establish the detailed contents of the time series display. The parameters contained in the window are of two types: general display parameters and channel specific parameters. The general display parameters are presented in the top half of the window and they determine the characteristics of the display for all channels. The channel specific parameters are presented in the boxed section in the bottom half of the window and they determine the characteristics associated with each individual channel. To view or edit the parameters associated with an individual channel, highlight the channel number in the Channel list box.

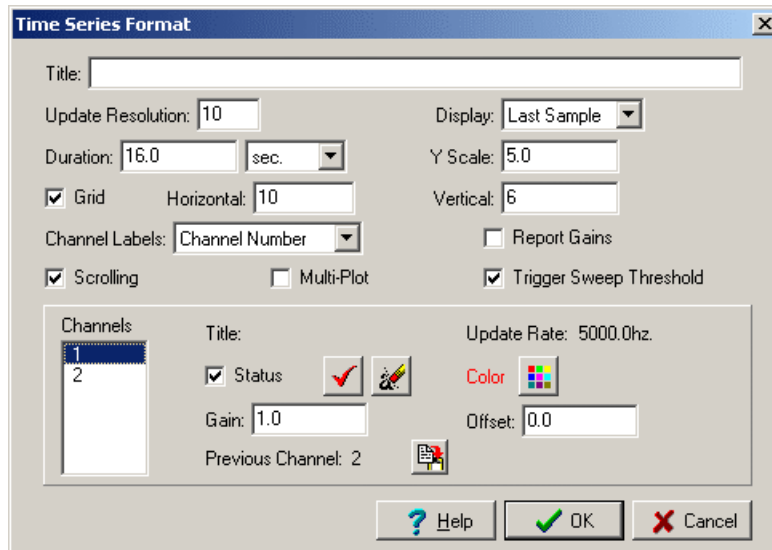


Figure L-9. An example of the Time Series Format window.

General Display Parameters


Title: A text string that appears at the top of the display to describe its contents

Update Resolution: A multiplier term that helps to determine each channel's Update Rate (the frequency that the display is updated for each channel). The update rate is equal to the channel's sampling rate divided by the update resolution. Thus, as the update resolution value increases the display is refreshed less frequently.

Display: Determines the value that is displayed for each channel each time the display is updated. There are three options: **Last Sample** (the last sample acquired in each interval), **Max** (the maximum value acquired in each interval), or **Min** (the minimum value acquired in each interval).

Duration: Determines the total time duration of the display. [The time base multiplied by the number of horizontal ticks in the display grid is equal to the display duration.]


Y-Scale: Determines the change in amplitude represented by one division of the display grid in the vertical dimension (the dimension bar located beside the top right corner of the display box indicates the same change in amplitude as one division in the display grid). The Y-Scale value applies to all channels within the display, and it is unitless since the amplitude of each channel may be measured in different units, depending upon the calibration parameters established for each. Also note that each channel in the display possesses its own individually adjustable gain value. Therefore, to determine the amplitude change represented by one division of the display grid for any given channel, divide the channel's gain value by the Y-Scale value. For example, if the Y-Scale value is 100, and a given channel's gain value is set at 5, then the amplitude difference represented by the distance between two successive grid lines is 20 ($100 / 5 = 20$).

 To increase or decrease the Y scale value, position the mouse pointer onto (or near) the corresponding channel number or title, then hold down the Control key as you click the right or the left mouse button, respectively. *This adjustment can be performed while data are being displayed in real time.*

Grid/Horizontal and Vertical: The **Grid** checkbox turns the display grid on and off. The values entered in the **Horizontal** and **Vertical** boxes indicate the number of divisions in the grid in each respective dimension.

Channel Labels: Determines how each channel is labeled in the display.

Report Gains: Check this checkbox to report the gains of each channel in the display. The display gains are indicated in parentheses following the channel label.

 Divide the channel's gain value by the Y-Scale value to obtain a measure of the signal amplitude in units per division of the display grid.


 The display gain does not affect the amplitude of the channel as it is stored in the data file.

Scrolling: This checkbox turns the smooth scrolling feature on and off. The scrolling feature produces an effect similar to a chart recorder in the sense that new data are constantly added to the right edge of the display once the display is filled, rather than erasing the display and starting at the left edge again. The display thus appears to scroll continuously, as if panning a camera from right to left.

 The scrolling and Multi-plot features cannot be used simultaneously.

Multiplot: This checkbox turns the Multi-plot feature on and off. When the multi-plot feature is on, successively acquired sweeps are superimposed on each other. In other words, data acquired in previous sweeps are not erased as new data are added to the display.

Trigger Sweep Threshold: When this check box is checked the trigger threshold level appears as a horizontal line within the display. Uncheck the check box to remove the horizontal line from the display.

 The threshold level appears in the display only when the acquisition **Mode** (in the Mode tab of the Acquire Format window) is set to Triggered Sweep or Triggered Sweep - RAM.




Channel Specific Parameters


Channel: A list box containing all of the active channels. Highlight an individual channel to view its parameter settings.

Title: Reports the channel of the highlighted channel.

Update Rate: Reports the frequency that the display is updated for each channel. The update rate is equal to the channel's sampling rate divided by the update resolution.


Status: Determines whether the highlighted channel appears in the display. Check the Status check box to include the channel. Clear the check box to exclude the channel.

 Use the  (**Select All**) button as a short-cut to check the Status checkboxes of all active channels. Likewise, use the  (**Clear All**) button as a short cut to clear the Status checkboxes for all channels.

Color: Reports the color used to plot the data associated with the highlighted channel (the color of the text is the color of the plot). To change the color, click the  (**Change Color**) button and select another color from the palette window that appears.

Gain: Determines the display gain of the highlighted channel. It works by multiplying the amplitude value of each data point in the channel by the Y Scale value, whichever applies. The units of measurement for the channel in question are determined by the calibration parameters established for it. Thus, they may be different for each channel.

Offset: Determines the vertical placement of the highlighted channel relative to its zero reference point (the zero reference point is the tip of the rightward pointing arrow located outside the left edge of the display box, beside the channel number or title). An offset value other than 0.00 is most effectively used when the common, or baseline, amplitude of the signal deviates sufficiently from amplitude = 0.00 to render the signal difficult to see in the display.

Previous Channel: Reports the number of the channel that was highlighted before the currently highlighted channel. Click the  (**Copy Previous Channel**) button to copy the parameters established for the previous channel to the currently highlighted channel.

L-8. Special Topics

The topics presented in Sections L-11.1 through L-11.12 describe in detail how to set up and use many different features of the Data Acquisition module.

L-8.1. The Acquisition Set-Up Wizard

The acquisition set-up wizard is not available at the present time. Please check our web site (www.runtech.com) for future updates.

L-8.2. Selecting An Acquisition Mode

Datapac 2K2 offers a choice between two basic acquisition modes -- **Continuous** and **Triggered Sweep**. The **Continuous Mode** is similar to a tape recorder in the sense that data are continuously recorded from the time the acquisition session begins until it is terminated. In contrast, the **Triggered Sweep** mode is similar to a traditional oscilloscope in the sense that the selected trigger conditions must be met before data are accumulated.

You also have a choice of two primary locations where the incoming data may be stored -- directly to the data file on disk or to RAM memory. Consequently, there are a total of four acquisition mode options, as described below.

Continuous: Acquires data continuously throughout the acquisition session, with no interruptions or gaps, and stores the data directly to the selected data file as acquisition proceeds. Since data must be transferred to disk while acquisition proceeds, the maximum sampling rate you are able to achieve is very likely to be limited by the disk transfer rate your computer system is capable of sustaining. Disk transfer may also disrupt other timing-sensitive activities which may be taking place at the same time. For example, if you are attempting to capture motion data in another application while you are acquiring data the Datapac 2K2, the other application may fail to operate correctly. If you receive an **Acquisition Overflow** error message -- which indicates that you are sampling too fast for the system to keep up -- or if your other application fails, try the **Continuous - RAM** option.

Triggered Sweep: Acquires data periodically throughout the acquisition session. More specifically, data are acquired for a selected interval around an event that satisfies the conditions of a trigger. To select the trigger conditions, click the Acquire Format window's Trigger tab. Since data must be transferred to disk while acquisition proceeds, the maximum sampling rate you are able to achieve is very likely to be limited by the disk transfer rate your computer system is capable of sustaining. Disk transfer may also disrupt other timing-sensitive activities which may be taking place at the same time. For example, if you are attempting to capture motion data in another application while you are acquiring data with Datapac 2K2, the other application may fail to operate correctly. If you receive an **Acquisition Overflow** error message -- which indicates that you are sampling too fast for the system to keep up -- or if your other application fails, try the **Triggered Sweep - RAM** option.

Continuous-RAM: This option is another continuous acquisition mode: data are continuously acquired throughout the acquisition session, with no interruptions or gaps. Under the Continuous-RAM option, the incoming data are temporarily stored in a memory buffer created in system RAM, then transferred to the selected data file when the acquisition session terminates. One of the most important advantages of the Continuous - RAM option is that it is less likely to interfere with simultaneously run applications than is the Continuous option. Another is the fact that since data can be transferred to RAM much faster than to disk, the maximum sampling rate achievable with the Continuous-RAM option is likely to be somewhat higher than with the Continuous option.

Triggered Sweep-RAM: This option is another triggered sweep option, where data are acquired periodically throughout the acquisition session, whenever a trigger is detected. To select the trigger conditions, click the Format window's Trigger tab. Under the Triggered Sweep-RAM option, the incoming data are temporarily stored in a memory buffer created in system RAM, then transferred to the selected data file when the acquisition session terminates. Since storage to RAM is more

efficient and less timing-sensitive than storage directly to disk, the maximum sampling rate you are able to achieve is likely to be somewhat greater than the Triggered Sweep option. You are also less likely to disrupt other timing-sensitive activities which may be taking place at the same time.

Setting up a RAM Buffer

When using the Continuous - RAM or the Triggered Sweep - RAM mode options it is necessary to reserve some portion of your computer's RAM memory as a temporary storage area for your incoming data. The size of this area is determined by the **RAM** parameter in the Mode tab. How much RAM should you allocate for temporary storage of your data? Basically, as much as you think you'll need. Keep in mind that every accumulated data point occupies two bytes of memory. Therefore, the amount of storage space needed (X) can be determined by the formula:

$$X = (2 * (N * S(i)) * D$$

Where:

N = the number of active channels

S(i) = the sampling rate of each channel (in Hertz)

D = the anticipated duration of the acquisition session

L-8.3. Selecting Channels to Acquire and to Display

Selecting Channels to Acquire

A channel is said to be *active* or *enabled* when it is selected to have data stored to it during an acquisition session. The active channels are jointly determined by the **Number of ADC Boards** and the **Channel Range** parameters that are found in the **File** tab of the **Acquire Format window**. The **Number of ADC Boards** determines how many A-D boards are currently active. The **Channel Range** determines the sequence of channels that are active on each board. When one A-D board is active, the channel range is defined according to the lowest and highest numbered channels to be included in the range. Consequently, you must activate channels in sequential order. For example, you can activate Channels 3 through 7 or Channels 5 through 16, but you cannot activate Channels 3, 5, and 7 without also activating Channels 4 and 6³. If more than one board is active the channel range applies to both boards – but the selected range values apply only to the first board. For example, assuming two 16 channel boards are being used, if you set the Channel Range to 1 to 4 you actually enable eight channels: Channels 1 - 4 on the first A-D board and Channels 17 - 20 on the second board (channels are numbered 1 - 16 on the first board, 17 - 32 on the second board, and so on).

Selecting Channels to Display

Just because a channel is active does not mean you have to include it in a real time display. The Acquisition Module allows you to independently decide whether or not to display a given active channel. Thus you can elect to store data in a channel without being required to display it in any real time display window.

The ability to store data in channels that are excluded from the real time display has two important advantages. First, it helps to improve focus and reduce clutter on the screen by allowing you to monitor only the channels of primary interest. Second, it allows you to improve the overall maximum sampling rate by reducing the CPU processing time needed to update the screen. Other ways to improve the maximum sampling rate are discussed in Section L-9.


³ You can, however, assign channels 4 and 6 Resolution values of 0 (zero), thus preventing the data acquired on those channels from being stored in your data file. See Section 8.4 for details.

L-8.4. Sampling Different Channels at Different Rates

The term, **sample period** refers to the interval between successive samples, or data points, acquired in the same channel. The sample period is the reciprocal of the **sampling rate**. For example, a sampling rate of 1000 Hz (1000 samples per second), corresponds to a sample period of 1 millisecond.

The **Base Sample Period** parameter in the **File** tab of the **Acquire Format window** determines the minimum interval between successive samples in any given channel. Since the sample period and the sampling rate are reciprocally related, the base sample period also determines the maximum sampling rate that can be applied to any given channel.

The Acquisition Module makes it possible to select a different sample period (and thus a different sampling rate) for each individual channel. The only limitation is that the sample period chosen for each channel must be an integer multiple of the base sample period. The multiple selected for a given channel is called that channel's **resolution**, and it is determined by the **Resolution** parameter, also contained in the **File** tab of the **Acquire Format window**. For example, say you wished to sample channels 1 through 4 at 2 KHz and channels 5 and 6 at 100 Hz. To do so, first set the Base Sample Period value to 500 microseconds. Then set each of the Resolution parameters associated with Channels 1 through 4 to 1 and set the Resolution parameters associated with Channels 5 and 6 to 20.

 Significant extra processing time is required to pack incoming data in preparation for storage when channels are sampled at different rates (or not at all, as explained below). On the other hand, since fewer samples are acquired per unit of time for channels with large resolution values, the amount of time required to transfer the data to disk is reduced. Thus, the two considerations offset each other. Though there is substantial variation among individual computer systems, in general the increase in processing time required to pack the data becomes less than the decrease in processing time required to manage disk transfer when a channel's resolution value is about 10 or greater.

Sampling Non-Sequential Channels

A new feature introduced in Datapac 2K2 is the ability to assign any channel a Resolution value of 0 (zero). A resolution value of 0 effectively turns the channel off, and this is how you are allowed to acquire non-sequential channels. For example, if you want to acquire only channels 2, 4, and 6, but not channels 3 and 5, set your Channel Range to 2 – 6, then set the Resolution value for channels 3 and 5 to 0 (zero).

An interesting feature of the Resolution parameter is that it only affects the way data are stored to the data file, not the way data are transferred from the A-D device into the computer. In actuality, all channels in the specified Channel Range are sampled and transferred to computer memory at the resolution defined by the Base Sample Period value. And since the data are all in computer memory, the software can therefore make use of it all before it decides what to store to a file. This fact has two important consequences. First, it makes all of the channels in the specified channel range available for viewing in your real time displays. Even channels that have been assigned a resolution value of 0 (and therefore not stored to the data file) can be viewed in a display. Second, if any channel with a resolution value other than 1 is used as the trigger channel in the Trigger Sweep mode, the accuracy of the trigger is determined solely by the base sample period. The channel's resolution value is irrelevant. Thus, for example, if the base sample period is 1 msec and a channel with a resolution value of 50 is selected, the transition across the threshold level is detected with an accuracy of 1 msec rather than 50 msec. This is true even if the selected trigger channel has a resolution value of 0. In other words, you can even use any channel in your channel range as your trigger channel even if the data accumulated from it are not subsequently stored to your data file.

L-8.5. Positioning Channels in Time Series Displays

The **Align** option in the menu bar of the Time Series type display window can be used to adjust the position of each channel or trace in the display. Each channel's position can also be manually fine-tuned as described below.

Using the Align Command:

Two options are available in the drop-down menu associated with the **Align** command: **Space** and **Collapse**. Select the **Space** option to equalize the vertical distance between the zero reference points of adjacent channels (the zero reference point is indicated by the small, right-pointing arrowhead immediately to the right of the channel title or number along the outside left edge of the display box). Select the **Collapse** option to combine the zero reference points of all channels in the display.

Manually Aligning Channels:

Individual channels can be re-aligned as desired by holding down the shift key, pointing to the desired channel number or channel title, then holding down the left mouse button as you move the mouse. A horizontal line appears in the display as you move the mouse to continuously indicate the current zero reference point of the channel. The channel number also appears below the bottom right corner of the display box to inform you as to which channel is being adjusted.

It is important to recognize that when channels are collapsed their reference points are combined. Consequently, though the combined zero reference point can be manually adjusted as described in the previous paragraph, channels cannot be moved individually until the channels are uncollapsed using the **Align|Space** option.

L-8.6. Marking Events from the Keyboard

The Keyboard Marking feature makes it possible to identify the occurrence of significant events during the course of an acquisition session. The feature is automatically enabled whenever you start an acquisition session, so there is nothing you need to do to enable it. To use it, just press one of the ten number keys whenever something of interest happens. Every time you press a number key an event is inserted into one of ten event files to log the time associated with the keypress. The total number of events that have been selected from the keyboard, regardless of the number keys used to selected them, is reported on the Acquire Control Panel and it is updated each time a new event is selected. Events selected in this way can be used in subsequent displays and analyses just like any other event.

How Number Keys are Associated with Event Buffers

Since a different event file is associated with each number key, up to 10 different sets, or categories, of events can be recorded. For example, if you are acquiring data from a subject during a reaching task, you can press the 1 key every time the subject reaches with his or her left hand (or paw), and the 2 key every time the subject reaches with his right. Each number key has a specific association with an event file linked to a specific event buffer. The 1 key is associated with the event file linked to buffer A, the 2 key with buffer B, and so on up to the 0 key, which is associated with buffer J. Event files are created and linked to a particular event buffer only when the corresponding number key is pressed at least once during the acquisition of a data file. Thus, for example, if the 2 key is never pressed, no event file is created and linked to buffer B.

Factors Affecting the Accuracy of Event Times

There are three main factors that affect the accuracy of event times recorded from the keyboard. The first is your reaction time -- the time it takes you to interpret what you observe and then press the key. The second is the time it takes the operating system to service the request it receives from the keyboard device. The third is the time it takes the A-D device to fill its on-board memory queue and then flush the information to the computer. These three factors contribute to a lag between when the event actually occurs and the time that is actually recorded. The duration of the lag cannot be determined with any real





accuracy, but it is likely to be on the order of a few hundred milliseconds. Keyboard marking of events is therefore best regarded as approximate.

There is one more factor that affects the accuracy of event times recorded from the keyboard which only comes into play when data are acquired using the triggered sweep mode. In the triggered sweep mode data are acquired only for intervals of time surrounding the detection of a trigger. We call this interval a "sweep". No data are acquired between sweeps -- that is, between the time that one sweep ends and another begins. By convention, if a key is pressed in the interval between sweeps, the time that is recorded for that event is the time associated with the last sample of the preceding sweep.

Duration of Keyboard Selected Events

Because of the way Windows operating systems interact with keyboard devices it is impossible to record the duration of a keypress. Therefore, the duration of an event recorded from the keyboard is always defined as one sample period.

L-8.7. Maximum Session and File Durations

The **Maximum Session Duration** and **Maximum File Duration** parameters in the **Mode** tab of the **Acquire Format window** serve as predetermining counters that respectively limit the duration of individual acquisition sessions on the one hand, and the total sampling duration represented by the entire data file. An **acquisition session** is defined as the period between the moment that the system becomes armed and ready to acquire data and the moment when the system is disarmed again. Thus, under normal conditions -- i.e., when neither the **Delay** or **TTL Start** features are being used -- an acquisition session begins when you click the  (**Acquire**) button on the Acquire Control Panel and ends: (a) when you click the  (**Scope**),  (**Acquire**), or  (**Stop**) button (or their keyboard analogs); or (b) when the **Maximum Session Duration** or **Maximum File Duration** values are reached, whichever comes first.


A given data file can be acquired over the course of many acquisition sessions. In other words, acquisition can be started, stopped, then started again many times as you acquire data to a single file. In some applications it is desirable for each session to be of the same length. That is the purpose of the **Maximum Session Duration** parameter. For example, if the value of the Maximum Session Duration is set to 10 seconds, then each session is automatically terminated 10 seconds after it is begun. Moreover, as each session is terminated the system is immediately ready to start another session of the same duration. Following the same logic, the **Maximum File Duration** parameter can be set up so that a known number of sessions are acquired to a given parameter file -- provided that the acquisition mode is set to **Continuous**. For example, if the Maximum Session Duration is set to 10 seconds and the Maximum File Duration is set to 50 seconds, then the system can acquire 5 sessions before the established file duration is used up. At that point, no additional data can be acquired until the Maximum File Duration is increased or until you create a new data file.


The statements just presented are true only when the Continuous mode is in effect because of the way a session duration is measured as opposed to the way the file duration is measured. The duration of a session is always measured in actual time elapsed, whereas the duration of a file duration is measured according to the amount of data stored in it. When the Continuous mode is in effect data are acquired and stored to the file continuously throughout the acquisition session. Thus, the duration of stored data is always equal to the duration of the acquisition session. In contrast, when the Triggered Sweep mode is in effect data are acquired and stored only during a sweep. Thus the duration of stored data is equal to the number of acquired sweeps times the duration of each sweep. In many triggered sweep applications the number of triggers encountered per unit of time varies widely. Consequently, though an acquisition session can still be set to, say, 10 seconds, there is no guarantee that the same number of triggers will be encountered in each session. And thus, the file duration may increase by a different amount over the course of each session.

When using the Triggered Sweep mode it is sometimes advantageous to define an acquisition session on the basis of elapsed time, regardless of the number of sweeps acquired in each session. In other situations, however, it is preferable to predetermine the number of sweeps acquired in each session, regardless of how long it takes. That can also be done with equal ease -- just set the **Max. # Sweeps** parameter in the Trigger tab of the **Acquire Format window** to the desired value. Also be sure to set the **Maximum Session Duration** parameter to a very high value to prevent the possibility that the session duration will elapse before the desired number of sweeps are captured.





L-8.8. Superimposing Sweeps

The Multi-Plot feature is available in the time series type of display window to allow you to superimpose data accumulated over the course of several sweeps. The Multi-Plot feature can be turned on and off in either one of two methods: by selecting the **MPlot** command in the display window's menu bar or by checking or clearing the **Multi-Plot** checkbox in the Time Series Format window. The two methods can be used interchangeably.

 Though the Multi-Plot feature can be used in both the Continuous and Triggered Sweep acquisition modes, it is primarily useful in the Triggered Sweep mode as a way of superimposing responses that are time-synchronized to the trigger.





 The Multi-Plot feature is not available when the smooth scrolling feature is active.


L-8.9. Erasing Portions of Already Acquired Data

The three  buttons on the top row of the Acquire Control Panel allow you to erase previously acquired portions of your data file. Specifically, the  (**Erase Last Session**) button to the left of the **Session** value lets you erase only the previously acquired session. Likewise, the  (**Erase File**) button to the left of the **File** value lets you erase the entire data file. And the  (**Erase Last Sweep**) button to the left of the **Sweeps** value lets you erase the most recently acquired sweep. Of course, the latter is only available when you are using the Triggered Sweep mode to acquire data.




The Erase Last Session and Erase Last Sweep buttons can be used repeatedly to erase multiple sweeps or sessions on a last in, first out basis -- that is, from most recent to least recent.

L-8.10. The Delay and TTL Start Features


Under normal conditions, an acquisition session is defined as the interval between the moment you select the  (**Acquire**) button in the Acquire Control Panel until the moment the session is terminated either by selecting the  (**Scope**),  (**Acquire**), or  (**Stop**) buttons or their keyboard analogs, or when the session terminates automatically (via the **Maximum Session Duration**, **Maximum # Sweeps**, or the **Maximum File Duration** parameters). "Normal" conditions are those in which the **Delay** and the **TTL Start** features are both disabled. When either one or both of these features are in use, special conditions apply, as described below.

 Even under normal conditions, however, the system is not necessarily storing data continuously during an acquisition session. That is only true when the **Acquisition Mode** is set to **Continuous**. When the mode is set to **Triggered Sweep**, data are stored only when triggers are detected. Nonetheless, the system remains armed, and incoming data are constantly monitored even between triggers. And thus, the acquisition session itself is said to be continuously in effect during triggered sweep acquisition as well.

The Delay Feature:

The Delay feature provides a way of automatically running several acquisition sessions without keyboard intervention. Specifically, when the Delay feature is enabled and a previous acquisition session is allowed to automatically terminate (via the **Maximum Session Duration** parameter), a delay interval commences. The duration of the delay interval is user-selectable. Then, when the delay interval times out, a new acquisition session begins automatically. The process is repeated until acquisition is turned off manually (by selecting the  (**Scope**),  (**Acquire**), or  (**Stop**) buttons or their keyboard analogs) or the **Maximum File Duration** parameter is reached.


The TTL Start Feature:

When the TTL Start feature is enabled, an acquisition session begins the moment a TTL pulse is detected at the TTL-IN port -- provided, of course, that you have already selected the  (**Acquire**) button in the Acquire Control Panel. In other words, the TTL-IN port is not examined for the occurrence of a pulse until the Acquire option is selected. Then, when a pulse is detected, the acquisition session begins.

The Delay Feature in Combination with the TTL Start Feature:




When the **Delay** feature is used in combination with the **TTL Start** feature the following conditions must be met, in order, before an acquisition session begins:

First Acquisition Session:

- (1) The  (**Acquire**) button in the Acquire Control Panel must be selected.
- (2) A pulse must be detected at the TTL-IN port.

Subsequent Acquisition Sessions:

- (1) The previous session must terminate automatically (via the **Maximum Session Duration** parameter).
- (2) The selected Delay interval must elapse.
- (3) A pulse must be detected at the TTL-IN port.

Any time you terminate a session manually (using the  (**Scope**),  (**Acquire**), or  (**Stop**) buttons or their keyboard analogs) the sequence is reset to the beginning. In other words, the session following manual termination is considered the first acquisition session as far as the sequence just described is concerned.

Using the TTL Start Feature as an Alternative to Triggered Sweep:

The **TTL Start** feature, in conjunction with the Delay feature and the **Continuous** acquisition mode, can be used as an effective alternative to the **Triggered Sweep** mode. Recall from the discussion earlier in this topic that the TTL Start feature can be used to trigger the beginning of an acquisition session. This situation is very similar to acquiring a sweep in the Triggered Sweep acquisition mode. But there are some important differences. For one thing, the TTL Start feature requires a TTL pulse for operation. There is no threshold adjustment possible in the TTL Start feature, as there is in the Triggered Sweep mode. Additionally, the TTL Start feature allows no pretrigger interval. The session always begins immediately upon detection of the pulse, and that is the only option available in the TTL Start feature. In contrast, the Triggered Sweep mode does allow you to set a pretrigger interval. Finally, the TTL Start feature does not allow measurement of the time that elapses between triggers. In the Triggered Sweep mode such measurements are computed and maintained automatically (by way of the companion event file).

No ability to set a threshold level, no pretrigger capability, and no record of trigger-to-trigger intervals are all limitations of the TTL Start feature when used as a replacement for the Triggered Sweep mode. One



other could be mentioned, although it is easily overcome: when a session times out the system is typically disarms itself. Thus, until the system is rearmed (by selecting the **Acquire** button), no additional sessions can be acquired. However, one can easily prevent the system from becoming disarmed by employing the **Delay** option. Assuming the selected delay interval is small (the value has to be greater than or equal to one base sample period), the system becomes ready to detect the next pulse almost as soon as the previous session is completed.

Despite the limitations just described, the TTL Start feature does have one advantage: the pulse input does not occupy one of the analog channels. In other words, the TTL-IN line is not considered an analog channel. Thus, the pulse signal coming into it is not (and cannot be) stored to the data file. In contrast, the Triggered Sweep mode requires the trigger channel to be one of the active analog channels.

L-8.11. Loading and Saving Data File Parameters

The parameters that govern the acquisition protocol -- i.e., all of the parameters contained within the Acquire Format window -- are referred to as the **acquisition parameters**. These parameters include the number of enabled A-D devices, the number of active channel ranges and their sampling resolutions, the acquisition mode in effect, as well as a few related parameters. Moreover, since the number and type of opened display windows are determined from the Acquire Format window, these parameters are also considered acquisition parameters. However, the acquisition parameters *do not* include those that format the individual displays themselves. The latter are considered **display parameters**.

Saving and Retrieving Acquisition Parameters

All of the acquisition parameters are contained within a single parameter file. Therefore, if you want to save all of the acquisition parameters you are working with to a user-generated file, all you have to do is to click on the  (**Save Acquisition Parameters**) button and enter a name for the file you wish to create. Enter only the filename prefix, not the extension -- the file is automatically assigned the extension .RFD. Likewise, when you want to retrieve those acquisition parameters, all you have to do is click on the  (**Load Acquisition Parameters**) button and highlight the appropriate filename.

Saving and Retrieving Display Parameters



Loading and saving display parameters is more complicated, owing to the fact that there can be up to eight individual display windows at the same time. Each display window can be formatted differently and, in the case of the Enhance Acquisition module, each display can be any one of several different types. It stands to reason that sometimes you will want to change the format of one display without affecting any others you may have open at the same time. But there may be other times when you will want to change the format of all your displays all at the same time. Datapac 2K2 allows you to do both -- it all depends upon where you access the Save Parameters option from.

Saving and Retrieving the Parameters Associated With An Individual Window

To save the parameters associated with an individual display, use the **File|Save Parameters** option in the menu bar of that window. Likewise, to retrieve a set of previously saved parameters for an individual window, use the **File|Load Parameters** option in the menu bar of that window.

It is also important to keep in mind that the parameters associated with each particular type of display are saved to a file with a unique extension. For example, time series display parameter files are assigned the extension, .sts, whereas slider display parameter files are assigned the extension, .ssl. **When attempting to retrieve a set of display parameters you must have the display window set for the appropriate type of display.** In other words, in order to retrieve a times series display parameter file the window you are attempting to retrieve them to must be set up as a time series display window. You set the type of display in each window in the Display Tab of the Acquire Format window.

Saving and Retrieving the Parameters Associated With All Open Windows

To save the parameters associated with all of your open windows at once, click on the  (**Save Display Parameters**) button in the Acquire Control Panel. Likewise, to retrieve the parameters associated with all of the open windows, click on the  (**Load Display Parameters**) button in the Acquire Control Panel.

When you use the Save Display Parameters button in the Acquire Control Panel to save the parameters associated with all of your open displays, what actually happens is that several parameter files are generated -- one for each individual display window and one additional file that tells the program where to find all the others and what window they came from. For the purposes of discussion we will call the latter the "group file". More specifically, the group file keeps a record of the names of the other parameter files that are generated. Each of these other parameter files are catalogued according to which window they came from (the displays are numbered 1 - 8) and what type of display it is (time series, slider, etc.). If you are using the Enhanced Acquisition module it is important to keep in mind that the parameters associated with different types of displays are saved to different types of parameter files, each with a unique extension.

When you use the Load Display Parameters button to retrieve the parameters associated with multiple windows, the program reads the "group file" and then retrieves the parameter files associated with each individual display according to its number. Thus, it will attempt to retrieve the parameter file associated with Display 1 and adjust the display accordingly, then Display 2, and so on. It is important to keep in mind that parameters will not be retrieved for a display that was not open when the group file was created. In other words, if you had display windows 1, 2, and 4 open when you used the Save Display Parameters button to save the parameters, then subsequently opened display window 3, no parameters will be retrieved for that display. Likewise, when you are using the Enhanced Acquisition module, it is also important to keep in mind that *in order to retrieve the parameters associated with a particular window, the type of display that window is set for must be the same as it was when the parameters were saved.* For example, say you had display window 1 set as a time series display when you saved the parameters. Then say you changed display window 1 to a slider display before you attempted to retrieve the parameters using the Load Display Parameters button. Under these conditions the parameters you saved for display window 1 will not be retrieved because the type of display has changed.

A Suggestion

Remember that the parameters that determine the number and type of display windows that are open are considered to be part of the acquisition parameters. Thus, just before you save the display parameters for multiple windows using the Save Display Parameters button, it is a good idea to save your acquisition parameters as well. Then, when you want to retrieve the parameters, retrieve the acquisition parameters first, then the display parameters. That will ensure that all of the numbers and types of displays are the same as they were when the parameters were first saved. This is a particularly good idea when you are using a macro to control acquisition.


L-8.12. Producing an Incrementally Numbered Set of Data Files

The auto-incrementing filename feature is a new feature that was introduced in Datapac 2000 version 2.34. Its purpose is to make it easy to produce sequentially numbered data files. To use this feature you are required to use as the filename prefix of the first file in the sequence a name that ends in a three digit number. For example, if you name your first data file, **dfile001**, then you can use the auto-incrementing filename feature to name subsequent data files **dfile002**, **dfile003**, **dfile004**, and so on.

Creating the first file in the sequence:

The first data file in an auto-incrementing sequence is named in the usual manner, as discussed in the topic, Naming a New Data File. However, *the filename's prefix must end in a three digit number.* For example, name the file **dfile001** so that subsequent data files are named **dfile002**, **dfile003**, **dfile004**, and so on.

Creating subsequent data files:

When you are ready to create the next data file in a sequence, click the  (New Data File - Auto Inc.) button in the Acquire Control Panel. Doing so closes the previous data file and creates a new data file whose filename prefix ends in the next higher three digit number. For example, if the previous data file was named **dfile001**, the new data file is named **dfile002**.

L-9. Factors Affecting the Maximum Sampling Rate

Many factors can affect the maximum rate at which data can be sampled. The most obvious factor is the capability of the ADC hardware device being used. For example, many of the A-D devices that RUN Technologies currently supports have a maximum sampling rate of 330 KHz. Other devices may have different maximum sampling rates. But it should be recognized that the maximum sampling rate of the ADC hardware device itself is rated under "best case" conditions. Specifically, the capability of the ADC hardware itself is the rate limiting factor only when the processing time needed to read the incoming data from the ADC device, to store the data to the designated target drive, to display the incoming data, and to perform whatever additional tasks are required, is less than the time it takes for the ADC hardware to capture the data. As computers and hard disks become faster and more powerful it is, in fact, becoming more common for the capability of the ADC device to be the rate limiting factor. But it is not always so, particularly with older computers equipped with slower hard drives. Therefore, the task of optimizing the sampling rate is one of optimizing the time required to display and store the data coming from the ADC device.

One factor that often has a profound effect on the maximum attainable sampling rate is the maximum data transfer rate of the target disk; i.e., the disk device (usually, but not necessarily, a hard disk) used to store the data file. Many specific variables can contribute to the determination of the maximum data transfer rate. Such variables often can include the type of processor (Pentium, Pentium II, Pentium III, Athlon, etc.), the clock rate, the presence and type of disk caching and disk compression in effect, the type of drive controller, the access time of the target disk, and so on. The data transfer rate varies considerably from one machine to another and from one target disk to another, and therefore it is impossible to determine with a high degree of accuracy what the minimum achievable sampling rate will be for a given system configuration without actually testing it. A reasonable estimate, however, based on a fully standard PC with a 80586 (Pentium) processor running at 200 MHz, and equipped with a local bus enhanced IDE or fast ATA controller, and a 12 msec average access time hard disk, is about 100 KHz for the Continuous acquisition mode. Significantly faster sampling rates are attainable on faster machines equipped with faster drives and drive controllers, however. On tests using a 933 MHz Pentium III equipped with an UltraATA 100, 7200 RPM hard disk with a 2 Mb cache, aggregate sampling rates in excess of 300 KHz were consistently attainable with real time display. In other words, sampling rates were consistently attained at speeds close to the A-D device's theoretical maximum.

Generally speaking, the Triggered Sweep acquisition mode also offers faster sampling rates. But the Triggered Sweep mode is heavily influenced by the number of sweeps accumulated per unit time. If your intended file size is not too large, then one of the best ways to enhance the maximum attainable sampling rate is to employ the Continuous-RAM or Triggered Sweep-RAM options, since these options create a primary memory buffer in system RAM to store incoming data during an acquisition session. Only when the session is over are the data transferred to the data file. Disk transfer is therefore not a factor during data acquisition, and increases in maximum sampling rate can be realized as a result.

Another factor affecting the maximum sampling rate is the processing speed of your computer. The processing speed increasingly comes into play as the number of processing tasks and/or their complexity increases. For example, when the CPU merely needs to direct data acquisition from the ADC hardware into RAM memory, it usually can do so faster than the ADC hardware can supply the data. Likewise, when the CPU additionally needs to direct transfer of the acquired data to disk, it can also usually do that faster than the disk can accept the data. However, when the CPU is also required to perform other processing tasks simultaneously with directing acquisition and storage, the likelihood that the processing

capacity of the CPU will become the rate-determining step increases as the number and complexity of those tasks increase.

There are a number of specific factors that can affect the amount of data processing required per unit of time. One very important factor is the processing time required by other applications that are running at the same time. Whenever possible, close all other applications before performing data acquisition. If that is not possible, try using the **Continuous-RAM** or **Triggered Sweep-RAM** modes. Another very important factor is the number and complexity of the real time displays that are open. The processing time that must be devoted to generating a real time display is principally affected by the number of pixels which must change state per unit of time. This consideration is affected by such factors as the number of channels included in the display, the sample period and display resolution, the display duration (the longer the better), and the size of the display window (the smaller the better). The scrolling feature available in the time series display is particularly processor intensive. Thus, if you have the scrolling feature active in one or more time series displays, you may experience a considerable decrease in your maximal sampling rate.

Another task that requires a significant amount of processing time is managing different sampling rates. In other words, when different resolutions are selected for different channels the amount of time required to pack the data prior storing it to a data file can be significant. On the other hand, since fewer samples are acquired per unit of time for channels with large resolution values, the amount of time required to transfer the data to disk is reduced. Thus, the two considerations offset each other. Though there is substantial variation among individual computer systems, in general the increase in processing time required to pack the data becomes less than the decrease in processing time required to manage disk transfer when a channel's resolution value is about 10 or greater.

Another important factor affecting sampling rate is disk optimization. It is important to realize that **the benchmarks indicated above assume that the target disk is optimized**. A disk is said to be optimized when the directories and files on it are organized in sequential, rather than fragmented fashion, and when the free space on the disk is arranged in adjoining sectors. When the free space on a disk is arranged in adjoining sectors it can be accessed more quickly, thus allowing maximal data transfer performance. As a result, higher sampling rates can be attained. A disk can be optimized by formatting it, but formatting a hard disk can be a time-consuming process. Moreover, formatting a disk will erase all of the information contained on it. A more efficient and desirable alternative method of optimizing a disk is using a disk optimization utility program. There is a disk optimization utility bundled with Windows 95 and subsequent versions called Disk Defragmenter.

Obviously there are a multitude of considerations which can affect the maximum sampling rate which you can effectively achieve. Moreover, the effects of many of them are difficult, if not impossible to predict with precision in all situations. For that reason it is important to ask, "What happens when the effective maximum sampling rate is exceeded?" Fortunately, the answer is that the Acquisition Module is smart enough to tell you -- at least in most cases. They have many built-in error checking features which allow them to monitor an acquisition session and to detect when it begins to fall behind. When those conditions occur the session is automatically terminated and an ACQUISITION OVERFLOW message appears on the screen. The data acquired prior to termination are retained. And in the overwhelming majority of cases the data are error-free. But it is important to keep in mind that although the error checking features are very accurate they are not absolutely foolproof. Thus, if you obtain an overflow message it is recommended that you closely inspect the accumulated data to verify that they are error-free.

L-10. The Purpose of The Companion Event File

Recall from Chapter 1, Section 1-2 that a data file is actually a collection of component files. One such component is called the **companion event file**. A companion event file is a special event file whose purpose is to maintain a record of the way in which the data file is segmented. For example, during triggered sweep acquisition the program automatically adds an event to the companion event file each time a sweep is acquired. The boundaries of that event serve as a record of when the corresponding

sweep began and ended and where it is located in the data file. Similarly, during continuous acquisition the program automatically adds an event to the companion event file each time a new acquisition session is run. The boundaries of the event serve as a record of where the data acquired in the corresponding session are located in the data file.

The companion event file is always linked to Buffer Z of the companion status file, and it can be used just like any other event file as input to the Datapac 2K2 data analysis modules. Many data analysis tasks can thus be performed concurrently with data acquisition. Details are provided in the next session.

L-11. Performing Other Activities Concurrently With Data Acquisition

The design of Datapac 2K2 makes it possible to perform other data display, processing, and analysis activities *concurrently* with data acquisition. What this means is that you can open windows devoted to other activities while you also have one or more real time displays open. Although the data in the other windows cannot be updated until you terminate an on-going acquisition session, you can update them immediately thereafter simply by returning the program's focus to the window of interest⁴. For example, to instantly review the data you have acquired, keep one of the standard (off-line) display windows open as you acquire your data. The standard off-line displays are described in Chapter 2. Then, as soon as you terminate an acquisition session, click on the display window to review the data. Additionally, if you have the Waveform Processing Module and have it set up to display the processed data in the display window(s) you have open, then you can review the data you just acquired in its processed form. See Chapter D for information on the Waveform Processing Module.

The windows devoted to event selection and data analysis tasks can also be kept open as you acquire data, and the program focus can also be returned to them as soon as you terminate an acquisition session, as just described. In most, but not all cases, however, some preparation must be performed before events can be selected or the data file can be analyzed. For example, before you can select events you must create one or more event files. Similarly, you must perform a signal averaging analysis or a histogram analysis before you can view the results. Nonetheless, many such activities can be easily arranged so that they can be completed within a few keystrokes or mouse clicks following the end of an acquisition session. Moreover, you can return the focus to the Acquire Control Panel and acquire more data at any time.

L-12. Acquisition Error Codes and Messages

During the operation of the Data Acquisition module, and especially after initial installation, you may experience a number of error messages. A number of the more common ones, and their remedies, are described below. For additional assistance, please contact RUN Technologies.

Acquisition Overflow: This message occurs sometime after an acquisition session or a scope session begins. It indicates data are being sampled faster than the system can manage them. For possible solutions, see the topic entitled Factors Affecting the Maximum Attainable Sampling Rate.

The following messages appear when you attempt to start an acquisition or a scope session. Note that this is not an exhaustive list. Only the more common alternatives are mentioned. A complete list of error codes can be found in a file named CBERCODE.TXT that resides in your Instacal program folder. Many of the descriptions found there won't tell you what to do to remedy the problem, but many causes are similar to those described below.

ADC Board <x> Error Code 1: One or more of your ADC boards cannot be identified, probably because they are not correctly listed and configured in Instacal. See Section L-13 for additional information.

⁴ To return the program focus to a particular window, simply click on it with your mouse.

ADC Board <x> Error Code 5: The base address switch on the ADC device configured as Board <x> (usually Board 0) is not set consistently with the base address parameter in Instacal. Alternatively, the selected base address conflicts with another device. See Section L-13 for additional information.

ADC Board <x> Error Code 15: No interrupt line is selected in Instacal. See Section L-13 for additional information.

ADC Board <x> Error Code 304: The selected interrupt line is not available. See Section L-13 for additional information.

ADC Board <x> Error Code 305: The A-D device driver is not installed correctly. Try uninstalling Instacal, then reinstalling it. If the problem persists, contact RUN Technologies.

ADC Board <x> Error Code 608: The selected interrupt line is not available. See Section L-13 for additional information.

L-13. Using Instacal

Instacal is the configuration utility used to configure the hardware drivers employed by most of the A-D device alternatives currently supported by Datapac 2K2. Thus, Instacal can be used to inspect and to adjust the hardware configuration parameters currently in use.

Instacal and its associated hardware drivers are not RUN Technologies products. They are produced by Measurement Computing Corp. (formerly Computer Boards, Inc.), the manufacturer of most of the A-D hardware devices we currently support. As a result we cannot control the operation of new versions or their compatibility with older versions. Consequently, the operation of the Instacal version you have may not be exactly as detailed here. Additionally, and more importantly, it is important to use the proper version of Instacal for the version of DATAPAC you are running. Older versions of the Acquisition module may not operate with the latest version of Instacal. Likewise, the latest version of Instacal may not operate with earlier versions of DATAPAC. If you are having problems that you think may be a compatibility issue, please contact RUN Technologies. As of this writing, all versions of Datapac 2K2 and all versions of Datapac 2000 ver 2.30 and higher require Instacal ver 5.12. It is specifically Instacal ver 5.12 that is described here.

To start Instacal, click the Windows **Start** button, then select **Programs|Computer Boards|Instacal**. An example of the Instacal main window is shown in Figure L-10.

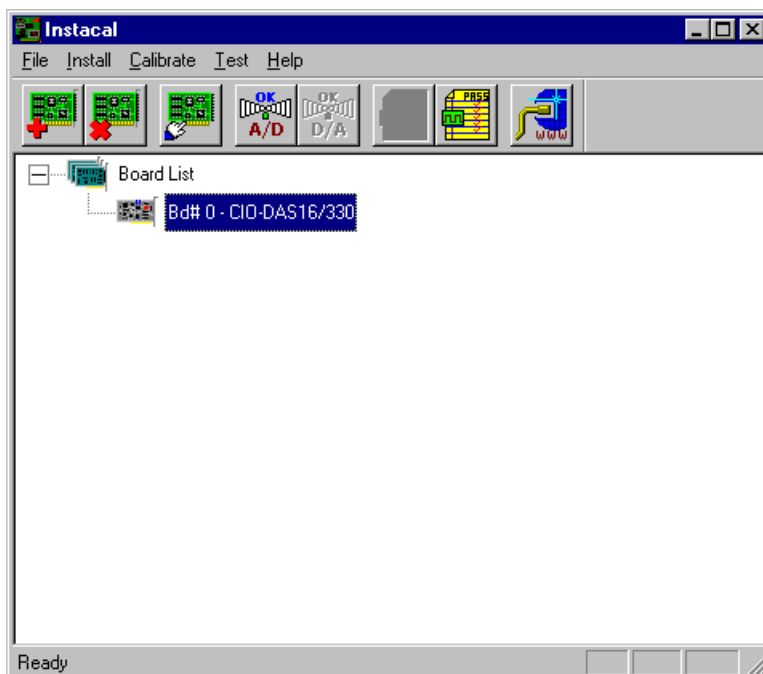



Figure L-10. An example of Instacal's main window.

Note that the example in Figure L-10 presents a **Board List**. Check to make sure the proper board(s) is/are listed in this list and that they are properly numbered (see the next section for proper numbering of your boards). If no devices are listed, if they are improperly numbered, or if the incorrect devices are listed, that probably explains why you received an **ADC Board <x> Error Code 1** message. ISA (desktop) style A-D boards (e.g., the CIO-DAS16/330, CIO-DAS16/330i, or CIO-DAS6402/12) can be selected and configured manually, as described below. In contrast, PCM (notebook) or PCI style devices (e.g. the PCM-DAS16/330, PCM-DAS16S/16, PCI-DAS1200J, and PCI-DAS6402/16) cannot be selected manually. Thus, if you are using a PCM or PCI device and your device is not listed, an unspecified device conflict probably exists in your system which is preventing your card from being recognized. Proceed no further and contact RUN Technologies for assistance.

Removing the Demo Board and Renumbering your A-D Devices


Unfortunately, during installation Instacal automatically inserts a "Demo Board" in your board list and assigns it the board number 0. The demo board must be removed and the remaining boards must be renumbered. To remove the demo board, highlight it in your board list, then select **Install|Remove Board**

from the main window menu bar or click on the  button in the tool bar. To renumber the remaining boards, point to the first board in the list with your mouse and click the right mouse button. Select the **Change Board Number** option from the list that appears, and set the **Board Number** to **0**. If you have additional boards, repeat for each remaining board, in the order that they appear, using successively higher board numbers (i.e., 1, 2, 3, etc.) until all of your boards are sequentially numbered beginning with 0.


Removing, Adding, and Configuring an ISA type A-D Boards

Read this section only if you have one or more ISA (desktop) style A-D boards installed in your system.

Removing an ISA Board:

To remove an incorrect device from your board list, highlight the board, then select **Install|Remove Board** from the main window menu bar or click on the  button in the tool bar.

Adding an ISA Board:

To add an ISA board to your board list, select **Install|Add Board** from the main window menu bar or click on the  button in the tool bar. A list of options appears like the one shown in Figure L-11. Highlight the model of the board you wish to install, then click the **Add** button. If you need to install more than one device, repeat the procedure just described as needed.

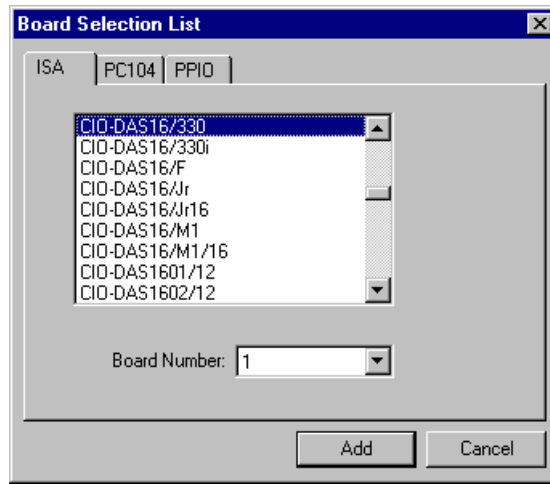


Figure L-11. An example of the ISA A-D device selection list.

The proper boards, and only the proper boards should now appear in your board list and they should be properly numbered. Now it is time to configure them.

Configuring an ISA Board:

Double-click the board you wish to configure in the board list. Upon doing so a table of parameters will appear. An example is shown in Figure L-12.

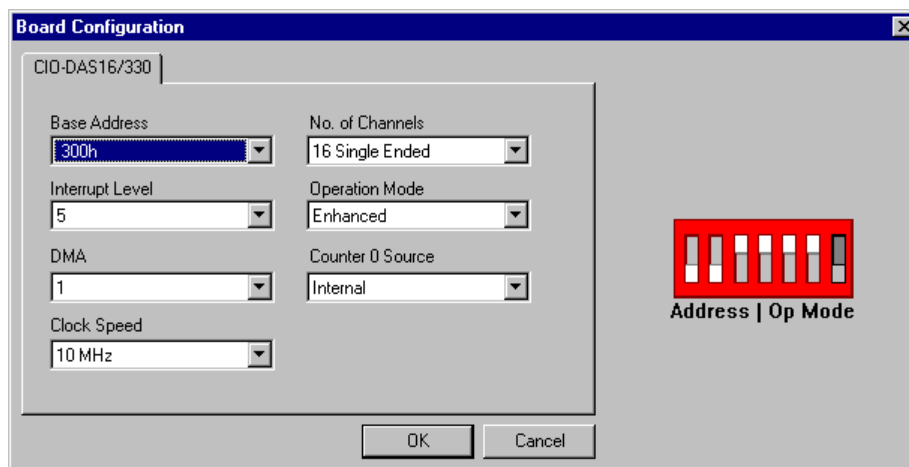



Figure L-12. An example of the ISA board configuration window.

All of the parameters *except* perhaps the **Base Address** and **Interrupt Level** must be set as indicated above in order for the device to operate correctly in the context of Datapac 2K2. The **Interrupt Level** is parameter whose proper value depends upon what is available in your particular computer system. Consequently, if you receive an error code indicating the specified Interrupt Level value is incorrect, just keep selecting different values until you find one that works. Each time you select a new value, exit Instacal, restart DATAPAC, and see if you can acquire data.

The **Base Address** parameter must be set to a value which is consistent with the Address/Op Mode switch on the A-D device itself. The Address/Op Mode switch settings are illustrated in the graphic shown on the right hand side of the window. Compare the switch settings in the illustration with the switch settings on your board. They should be the same. If they are, then you must select a new Base Address value and adjust the settings on your A-D board to match it (**power down your computer first!**). If they are not, change the Base Address value until they do. Then exit Instacal, re-start DATAPAC, and attempt to acquire data. If the same error message appears, exit DATAPAC, return to Instacal, and select another Base Address value. This time, however, you must adjust the settings on your board.

 **NEVER adjust the switch settings, or tamper with the board in any way, while the power is on.**
ALWAYS power down your computer first.

Configuring PCM or PCI type Devices

Read this section only if you have one or more PCM (notebook) or PCI style A-D devices installed in your system.

PCM and PCI devices are autodetected by Instacal. If your device does not already appear in your board list, an unspecified device conflict probably exists in your system which is preventing your card from being recognized. Proceed no further and contact RUN Technologies for assistance.

Before configuring any device, be sure the Demo Board entry is removed from your board list and your remaining boards are properly numbered. See the section above entitled, **Removing the Demo Board and Renumbering your A-D Devices** for details.

To configure a device, double-click on its name in the board list. Upon doing so a table of parameters will appear. An example is shown in Figure L-13.

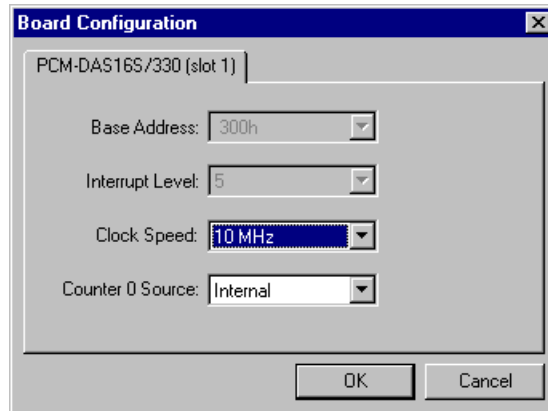


Figure L-13. An example of the configuration parameters associated with a particular PCM A-D device.

The example shown in Figure L-13 happens to show the configuration parameters for a PCM device. The configuration parameters for PCI devices are similar, with the addition of one more parameter: the Number of Channels. In any case, if the option is provided (parameters will be greyed out if they cannot be adjusted), make sure the **Clock Speed** is set to **10 MHz** and the **Counter 0 Source** (or **Counter 3 Source**) is set to **Internal**, and the **Number of Channels** is set to **16 Single Ended** or **64 Single Ended**. Repeat as needed for any additional devices. Then exit Instacal. The process of exiting Instacal updates the configuration parameters.